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APPLIED SCIENCE

INCORPORATED WITH

TRANSACTIONS *of the* UNIVERSITY *of* TORONTO ENGINEERING SOCIETY

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DEAN GALBRAITH

Fifty years ago this Fall a raw youth, of Scotch descent, bearing the honors of Port Hope High School, a collegiate now famous for the large number of distinguished scholars who received their early training within its walls, registered as a freshman in Arts at the University of Toronto. The new environments had for him the same awe and bewilderment as they still present to any raw recruit, unaccustomed to the new and unfamiliar sphere of life; but in those days there was much more cause for anxiety in the heart of a freshman than in the present day of a much milder form of initiation. This lad who scanned the corridors and lecture-rooms with curiosity, and regarded his professors with all due homage, was John Galbraith. His heart, no doubt, beat fast at thought of the mysteries to be unfolded to him by his learned instructors. His sleep perhaps was disturbed by visitations of sophomore ghosts, the result of well founded fears of the inevitable hazing which he must undergo. This ordeal which is fitly expresed in "Litoria" in the words—

"He's brought before ye Mufti's throne,
'Mid sulphurous fumes and muffled groan, etc."

was indeed sufficiently trying to test even the stoutest heart.

Being of an aggresive nature, the corners soon were rounded off and he adapted himself to his new surroundings and became an active figure in undergraduate affairs. While he was always prominent in his academic work, he by no means confined himself to studies alone, but was what is commonly called a "mixer" among students. Athletic activities and social functions of the undergraduate body always proved welcome fields for the application of his enthusiastic energies, and we have no doubt but that his supreme delight was to satisfy himself that the freshmen were given as hearty and forcible a reception under his regime as was accorded him the year before.

It is interesting to compare the University of his student days with the University of to-day and mark the wonderful growth which has taken place. The courses of study were few and the classes small. Those who intended to follow engineering work were taught mathematics and a little chemistry, which would compare very unfavorably with the courses in the sciences, pure and applied, which are now on the curriculum. New faculties have been created in the University, new colleges have been affiliated with it, until now, instead of one concentrated college, we have many branches or colleges united into a stronger whole with a broader outlook. The athletic activities of fifty years ago were limited practically to inter-class contests. Compare the soccer football games of that day, played on the rough sod with unhewn goal posts, before a bare handful of spectators, with the rugby games of to-day, with all their club and team organization, the enthusiastic organized rooting, and the music and color schemes used for the entertainment of the thousands of spectators and the encouragement of the players who are doing their unselfish best to uphold the honor and glory of their Alma Mater. Undergraduate societies and fraternities have been multiplied, affording new channels for the development of the student members.

Dean Galbraith, during the last half-century, has been watching with careful eye the gradual changes and developments of the University and has spent that portion of his life in undivided effort to be of the greatest possible value to his Alma Mater. After a few months of University life, this original collegiate youth gradually gave way to a self-possessed, confident and diplomatic individual, who, though comparatively young, was looked upon as a leader among his class mates. He seized every opportunity to develop his faculties and render himself of greater assistance to his class and classmates. This constant mixing with his fellow students and the active part which he took in all University affairs, taught him the art of self control, taught him appreciation for his fellow students who were to be his fellows in the professions of future years, and developed him mentally and physically and morally, so that upon graduation he had learned to realize the sentiments which actuate worthy men of any profession. He recognized the opportunities which lay before him, to be of some service to his country, to his fellowmen, and to the profession which he followed, and to reflect honor and credit upon his Alma Mater. He not only realized those opportunities but he grasped them with a grim determination that if concentrated and consistent effort would bring success, he would succeed. Through his own perseverance, his diligent application to his duties, and his faithful adherence to his high ideals, he has succeeded to a degree which few men have attained.

Evidence of his success may be witnessed in the Faculty of Applied Science and Engineering as it exists to-day. During the last thirty-five years he has instructed thousands of students in the art of engineering and he has his reward to-day in seeing them occupy the very foremost positions in the engineering world. In the early days of the "School of Practical Science" all the engineering lectures were given by Professor Galbraith, as well as the field instruction in surveying. The early students were indeed fortunate on account of the small classes, in having so much of their preceptor's attention, for in so doing they felt the inspiring kindness of his heart and realized the unselfish interest which he cherished for his students and for his profession. While his technical knowledge and his breadth of view led them to feel that they were under the guidance of a master mind, his untiring patience, his kindness and interest in each of them, and his sympathetic nature won the highest respect and fondest regard of every one who received instruction from him. This intimate association with the undergraduates enabled him to properly appreciate the position and capacity of the student. His interest in his students did not cease upon their graduation, but he kept in touch with them afterward and looked upon his old students as his children. The classes have grown to such numbers under his leadership, and the courses have so expanded, that he is no longer able to keep in intimate touch with all the student body, but his sterling qualities of mind and heart and the kindness and human attractiveness of his personality have endeared him to the heart of every "School" man. The engineering profession in Canada owes more to him than any other person, and our hearts swell with pride when we think of the part which he has played in "fathering" and developing the "School" since its foundation and in turning out men imbued with his high ideals and bettered by his worthy and kindly influence, to develop the resources of our fair Dominion. He is one of the very few men of our universities who properly appreciates the position and capacity of the student. The fact that he has one son, a recent graduate in engineering and another at present an undergraduate, enables him to still further understand the position of the undergraduates. In preparing a curriculum his object is always to provide in the best possible way for the students' needs, not to make the curriculum suit as conveniently as possible the courses of lectures which must be given. He always has been, is and always will be the students' friend, and it is this fact, and the qualities in him which account for this fact, that cause him to be held in the very highest respect and admiration by both the graduates and undergraduates.

Dr. Galbraith, had he chosen to follow the practice of his profession, instead of teaching, would undoubtedly have reached before this the top of his profession in Canada. In 1909 the respect which he had won in the engineering world and the attainments which he had acquired in his profession were recognized in his election as president of the Canadian Society of Civil Engineers, the representative society of the engineering profession in Canada.

His work on the Royal Commision on the Quebec Bridge disaster is a worthy testimony to his engineering ability. We are indeed exceedingly glad to see the Dean enjoying such robust health and he no doubt will be of immense value to the University for years to come.

The graduates in the Faculty of Applied Science and the University owe him a debt which can never be repaid. We trust that he may continue to be our chief adviser for many years, for in him we have a sympathetic adviser who has at heart the welfare of every member of his "School" family.

These feelings of respect and admiration are entertained not only by those intimately connected with University circles, but by the business and commercial world in general. That he is worthy of the high regard in which he is held by all who know him is evidenced in the following quotation from Morgan, "Canadian Men and Women, 1912":—

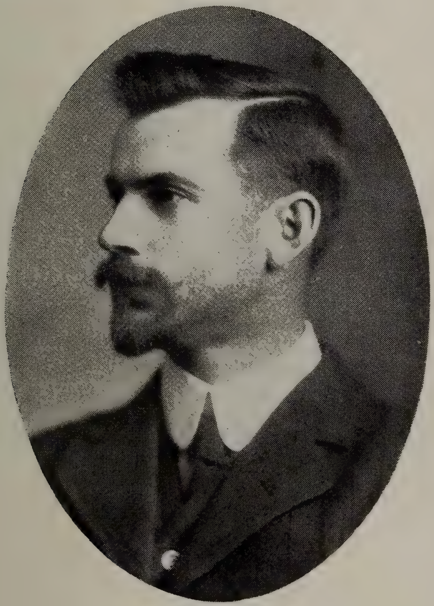
> Galbraith, John, civil engineer; educationist.
>
> S. late Thos. and Jane (Anderson) G.; b. Montreal, Sept. 5, 1846; e. Port Hope Grammar Sch., and Toronto University (B.A. with double scholar. in math. and genl. proficiency; gold med. in math.; and Prince's prizeman, 1868; M.A., 1875; LL.D. hon., 1902); LL.D., hon., Queen's Univ., 1903; m. 1886, Emily, y. d. late Capt. R. D. Stupart, R.N.; studied engineering and surveying under Geo. A. Stewart, Chief Engr. Midland Ry., P.L.S.,; D.L.S.; employed on construction Intercol. Ry.; Midland Ry. extension to Georgian Bay, and in connection with the C. P. Ry.; on the formation of the Sch. of Practical Science for Ont. 1878, was apptd. to the chair of enging. therein; since 1889 has been principal of the sch.; is now in addition thereto, Dean of the Faculty of Applied Science and Enging., Toronto Univ. (presented with his portrait in oils by the graduates and undergraduates ("in appreciation of his services and worth," 1908); was one of the founders of the Can. Soc. C. E., and long a councillor thereof; elected presdt. do. do., 1909; is also an assoc. mem. of the Inst. of C.E., Eng.; has also served as V.-P. of the Can. Inst., Toronto; apptd. a mem. of the Royal Comn. to investigate and report on the collapse of the Quebec Bridge, 1907 (see an appreciation in Enginering News, Feb. 5, 1908).
>
> "A thoroughly trustworthy man, thorough in training, honesty and patience."—Rev. Principal Falconer (q.v.)
>
> "In a world where men are aggressive, crowding and pushful, it is gratifying to see now and then, a man who is quiet and retiring brought out whether or no, and placed in front, where his attainments entitle him to be."—S. N.

ENGINEERING AS A PROFESSION

An Address Delivered by Walter J. Francis, C.E., before the Engineering Society of the University of Toronto in Convocation Hall, October 15th, 1913.

Mr. Chairman, President Falconer, Dean Galbraith and Fellow Students:—

I can assure you I appreciate very greatly the honor you do me in asking me to come to address you on the occasion of this, the opening meeting of 1913-1914. The pleasure is all the greater since it is to me a home coming, not only to the city of my birth and of my people, but to my alma mater where I am surrounded by a host of friends and old acquaintances. This occasion recalls the honor that I feel in being counted one of the graduates of the University of Toronto, and it reminds me quite forcibly of the happy days of twenty-four years ago when I had the pleasure that some of you are now experiencing of attending my first meeting of this Engineering Society.



W. J. Francis, C.E.

At the old grammar school on Jarvis Street, which doubtless many of you look back to fondly as the institution from which you have just graduated, I recall quite clearly the instruction I received from my English master, the late Wm. Houston, that the proper way to commence a speech was with some happy felicitation which possibly had no particular connection with the subject in hand. You will now observe that I am following his precepts, and that as yet I have made no reference whatever to "Engineering as a Profession."

Indeed, I find some difficulty in knowing just where to begin and where to end. Not long ago one of the pictures in "Life" showed a burglar who had just entered a living room with a dark lantern in his hand. Hearing a voice, the burglar turned the lantern in its direction and threw if full upon a talkative parrot. The parrot gazed at the lantern for a few moments and then said to the silent burglar, "For the land's sake say something, you make me nervous." That same parrot not long afterwards, while in his cage on the outside verandah espied a dog coming along the path, and in his desire to say something addressed the dog thus, "Sic, sic, sic him." The dog looked in every direction and seeing nothing to sic but the parrot, proceeded to knock that worthy out of his cage. In escaping to a point of safety, the parrot, after stroking down its feathers, commented to itself, "Polly, you talk too blamed much." Evidently the parrot knew there was a happy medium. As time wears on I shall endeavor to keep the happy medium in mind.

Your president has selected for me the subject on which I am to address you, namely, "Engineering as a Profession." I should much prefer to have given a little descriptive talk on some engineering work as being the easier course for me, but I felt that his suggestion that I might choose some other subject was prompted by his politeness and obliging ways, and that he really wished me to take up the subject which he named.

So far you will have observed that I have followed out the old precept already referred to and have said nothing.

Engineering is such a material thing, such a practical thing, and such an engrossing thing, that it is very difficult to talk about it in the abstract. Moreover, the engineer is known as a man who does things and one who is doing things is too busy to talk. You will, therefore, appreciate the greater difficulty experienced by one who is supposed to be an engineer talking in the abstract on such a subject as engineering.

In order that we may have some appreciation of the subject, it is necessary for us to arrive at some definite understanding of the two words, "Engineering" and "Profession," although I cannot promise you that these definitions will entirely sweep away the mist.

We all have our ideas of what a profession is, yet it might be very difficult for us to name many professions, and, having named them, to state the reasons why they are professions. Probably the first of the professions that would come to our mind would be that of law, medicine and theology. Later we add pedagogy, dentistry, architecture, and surveying. Some might even go so far as to add engineering. The predominating characteristic of all these callings is their protection by law and their recognition as lawfully constituted bodies by the powers that be and by the people themselves. The distinguishing feature of a profession is that it requires its members to have special training and to perform mental rather than physical labor. Custom has decreed that an individual member must earn his livelihood by his chosen profession. The representative society or societies of each profession have a written or an unwritten code of ethics. This code requires, amongst other things, that the remuneration received by a member for his services shall not be in any way contingent upon the result of his work, or, in other words, the professional man may not share in the profits. Thus, a lawyer may not, theoretically at least, accept a case on the understanding that he will be recompensed only in event of a victory over the opposing party, or a doctor may nor perform an operation on the understanding that his fee be greater if his patient should live than it would be if he should die. Further, the law recognizes more or less, certain fees that must be paid in court for the services of certain professional men, the surveyor, for example. You will doubtless be pleased to learn that the law allows a surveyor six dollars a day for attendance in court, while engineers and other ordinary mortals receive one-dollar-and-a-quarter as an emolument for such service.

The standing of the professions in the popular mind is due largely to the character, ability and dignity of the men engaged therein.

The societies representing the professions are the result of the interest that the leaders of the professions have taken in order that the professions may be recognized as such by the world at large.

Generally speaking, a man is no longer considered a member of a profession when he ceases to earn his livelihood by the practice of the profession. A dentist leaving his calling to become a vendor of real estate is no longer considered a dentist, although he has had his training and may still be holding his diploma. A doctor may have received all his degrees and may have practised for decades, but let him devote his energies to commercially exploiting, say, some well-tried prescription and the medical profession no longer recognizes him as a member. And so we see that the connection of earning that which is needful to purchase food, clothing and the necessities of life is intimately connected with the recognition of a person as a member of a profession. So much for the meaning of the word profession. Later, I shall return to the application of the term engineering as a calling.

It is more difficult to define engineering. What is an engineer? I confess I have been trying for twenty-five years to find out—and I am still trying. I remember two boys, now both on the list of graduates of this University, arguing about whether a civil engineer should know all about a locomotive or not. He thought he should. I didn't know. The other fellow is now practising surveying. Once I heard a judge of the Supreme Court of the United States struggle with the definition of an engineer in a brilliant twenty-minute speech, and he wound up by concluding that he didn't know anything definite about engineers excepting that they were jolly good fellows. In the daily press we often read of engineers, but before we get through the description we are fully aware that the person referred to drove locomotive No. 522 between two given stations at seventy miles an hour, or that he was the man who turned the throttle valve of the engine in the hold of the excursion boat.

The term engineer is very much overworked. It is not surprising that the great public gets confused in the multiplicity of engineers that are sometimes referred to. There is the civil engineer, the mechanical engineer, the military engineer, the electrical engineer, the hydraulic engineer, the sanitary engineer, the municipal engineer, the production engineer, the publicity engineer, the mining engineer, the chemical engineer, the structural engineer, the bridge engineer, the elevator engineer, the harbor engineer, the stationary engineer, the government engineer, the city engineer, the town engineer, the tunnel engineer, the country engineer, the marine engineer, the railway engineer and the consulting engineer.

Mr. Dunn, the president of the American Institute of Electrical Engineers, in Boston last year referred to twenty-seven recognized classes of engineers, and I understand that someone of a statistical turn of mind has succeeded in isolating over one hundred and ten separate and distinct varieties of the bacterium "Engineericus Universalis." Is it any wonder the public gets confused?

Compared with the professional men of law, medicine and theology, the engineer never comes to the attention of the public as a learned man doing things. Let a man be a member of the other professions and as soon as he begins to accomplish things he will be heard of. Let the geologist make a speech on his chosen subject and the newspapers of the land will blaze forth with startling headlines that Professor Geologus has unlocked the great secrets which Mother Earth has hidden in her bosom for millions of years. Professor Haultain accounts for this by the fact that the geologist takes time to tell the people what he is doing and what he thinks he has discovered. Let the lawyer defend some celebrity, whether famous or notorious, and before many hours the whole world will know it and will be gazing upon indifferent pictures of that lawyer. I think I am safe in saying that the engineer may devote his life to the service of the world and die doing his duty, and yet never be heard of during his career, unless he, unfortunately make an error in judgment or a slip of some kind. I venture to suggest that Quebec Bridge was more widely known by its failure than it or any other bridge will be in its success. I do not know that the engineer cares particularly about publicity, for he is too busy doing things. I am referring now to the recognition or non-recognition of his professional existence by the great public. Anyway, he is too busy doing things to stop for the sake of publicity. One of the powers that the engineer under-rates is the power of the press. Summing up, it would appear that the public has, at the best, a very hazy idea of what engineering is. Every engine runner of the country is an engineer, no matter whether he operates a locomotive or a threshing machine. Even the plumbers try to play the title and have in our own country succeeded in getting an association incorporated under the name of the Canadian Society of Sanitary Engineers. All respect to the man who can wipe joints and collect his bills of world-famous magnitude, but it looks very much like trespassing on the dignity of the name of the great recognized engineering body of Canada, the Canadian Society of Civil Engineers. It is, indeed, a most fortunate thing that the motorman does not term himself a street car engineer, that the chauffeur does not call himself an automobile engineer, and that the aviator does not wish to be known as a monoplane or biplane engineer. I was just wondering, if the analogy were carried on, what the man would call himself who runs a wheel barrow.

There are in every country recognized engineering societies having for their object the betterment of the profession and the uplifting of its members, all of whom are required to have certain pre-requisites of training and experience. In Canada there is The Canadian Society of Civil Engineers, in Great Britain the Institution of Civil Engineers. In the United States the American Society of Civil Engineers takes a corresponding place with, however, the addition of very strong societies known as The American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers. We have in Canada also the Mining Institute of Canada. In the constitution of the Canadian Society of Civil Engineers and of the Institution of Civil Engineers the art of engineering is defined, but so far as I know, no definition is given by the other bodies I have named. The definition used by The Institution is that devised by Tredgold, well nigh a century ago. He calls engineering "the art of directing the great sources of power in nature for the use and convenience of man." The Canadian Society of Civil Engineers has based its definition on the same formula in the words, "the profession whereby the great sources of power in nature are converted, adapted and applied for the use and convenience of man." With definitions such as these given us by two of the leading English speaking engineering organizations it is not surprising that the public has some difficulty in comprehending what an engineer really is, that is, assuming that these definitions ever reached the public. I think it may fairly be said that you could not be considered much of an engineer when you first learned to overcome the law of gravity and stood on end to direct that great source of power in nature to your use and convenience. It has truly been said that the greatest source of power in nature is the tongue of a woman, nevertheless to your engineering ability could not be applied any other definition than that of "contriving" when you succeeded in getting your mother to persuade your father to buy your first rubber boots. We are told that this definition of Tredgold was primarily intended to distinguish the military engineer from the civil engineer. I think there might be some difficulty in endeavoring to apply Tredgold's definition of a civil engineer to the military engineer because that military engineer would not find it easy to convince his enemy that the cannon balls were for the use and convenience of said enemy, even if there were any enemy left to argue with. Maybe my lack of soldier enthusiasm prompts the remark. The conflicts for the necessities of life are surely serious enough without adding other struggles blazing with uniforms, glittering with cold steel and reeking with blood. But we must not forget that in the olden days much of what is now known as "public work" was done under the direction of the military authorities who possessed the only complete organization of the time.

Professor Swain has perhaps unconsciously given a definition which, it seems to me, excels all others, where he calls engineering "the application of the laws of nature, the principals of mechanics and materials of construction to the business of the world." It seems to me that we have in these words a definition of engineering in its broadest sense.

This definition brings me right up to the present moment speaking to you as a body of young men who have entered one of the great engineering schools to learn something of how to apply "the laws of nature, the principles of mechanics, and the materials of construction to the business of the world." You have, I repeat, come to a great institution. Its graduates are to be found everywhere making good. Go from Tyrrell on the north to Laschinger on the south, start with Lash in Java and encircle the world, and you will find the alumni of Toronto. I myself am proud to be on the same list as Duggan, Stern, Thomson, Wright, Ross, Deacon, Mitchell, Fairbairn, Speller, Angus, Chalmers—I should not have started to name them personally, because I want to name them by hundreds—an honor list of which everyone should be proud. It has been said of Sir Christopher Wren in St. Paul's, "If you would see his monument, look around you." I say to you—and I say it with pleasure in his hearing—if you would see the monument of John Galbraith, just look around the world at the engineer alumni of Toronto.

The definition necessarily implies broad-mindedness. You cannot be a good engineer and be narrow-minded. So do not forget that this broad Dominion has other universities, older ones in the Old East and newer ones in the New West. Queens and McGill are great universities. There are many great universities in the States. England has a great number of the highest engineering schools in the world. So has France. Germany was well advanced with engineering before some of the other countries began to be serious about it.

But your university training will not make you an engineer. It will equip you to become an engineer—if the engineering spirit were born in you. By hard work and the application of the training you will here receive you will, I trust, all become engineers.

Now, I have discussed professional standing, and I have discussed engineering, and I have discussed university training. You are now doubtless realizing the difficulties surrounding "engineering as a profession." If you eliminate all those engineers who share in the profits of their labors you will see that you come down to a comparatively small number of men—small as compared with the number composing the profession of law or medicine. Yet you cannot say that those you have eliminated are not engineers. On the contrary they are engineers in every sense of the word and they are so recognized by all the great national engineering organizations. Many of the leading ship builders, bridge builders and contractors are amongst the best engineers of the world and they have and are occupying the topmost positions of honor in the engineering world.

The idea of a part of the engineers taking a stand shoulder to shoulder with the other professions is growing fast. Already a powerful movement is taking place in this direction, and it is interesting to note here that the indefatigable secretary of the only really professional organization of engineers was a member of the class of 1884. I refer to Eugene W. Stern, secretary of the American Institute of Consulting Engineers. Let me, in passing, call your attention to the pre-requisites of membership with these professional-engineers—some of you have a long way to go yet—a member must be at least 35 years of age, he must be actively engaged in the independent practice of the profession, he must be a full member of one of the great recognized engineering bodies, he must have a high character; he must have attained a degree of eminence in the profession, and he must not be engaged in contracting. When you come to realize the requirements for admission to any of the great recognized engineering bodies and add to them all the other stipulations I have named you will see that the standard set up by the American Institute of Consulting Engineers is one of which the engineering world should be proud. The membership is jealously guarded and, of course, it is not great in numbers. At present I think there are less than 70. You will be especially interested to know that of these one of every sixteen is a graduate of Toronto. This organization illustrates to some extent the difficulties surrounding "engineering as a profession." One is forced to conclude that engineering is too great and too comprehensive to ever be confined within the narrow limits of a "profession" in the same way as law and medicine. As it looks at present, we should associate ourselves with the recognized engineering bodies first and, later, if our choice take us in that direction, the Institute of Consulting Engineers. In the meantime study the work that the Canadian Society of Civil Engineers is doing. You cannot do this more easily than by getting in touch with Mr. James, or Mr. Garrow, the chairman and the secretary, respectively, of the Toronto branch of the Canadian Soicety of Civil Engineers down on King Street.

As I look at the whole question, that there are in this world two classes of people, the producer and the non-producer, and you will see before I get through that I am somewhat of an optimist. At the bottom of the non-producers I place the real estate men and the speculators. At the top of the producers I place the agriculturist and the engineer. Between these extremes live all the other callings, and I shall leave you, each for himself, to place them according as they may in your judgment be producers or non-producers. Under our present social system the agriculturist must come first, because we must have food and clothing. Next in order in the world's progress is the engineer. The Indian in his native state, the Arab with his caravan has no need of the engineer. The farther we get from the primitive, the greater the need of those who are able to apply to our use and convenience the great sources of power in nature. The marvelous advances of the last century are engineering advances. The other professions are older than engineering. Art is centuries old, yet it is a question if the art of to-day is on the same plane as that of Greece and Rome centuries ago. The greatest examples of the work of modern architects are based on the ancient orders and, the advances of architecture in modern times are due to the engineer in introducing steel skeletons and reinforced concrete. In surgery wonderful progress has been made within a lifetime, but the skill of noted surgeons was developed only through the medium of the engineer's handiwork in fine instruments and electrical appliances. The physician heals the sick and deals with individuals, while the engineer holds in his hand the health of towns, cities and nations. The preacher has no particular use for the engineer excepting as illustrations in sermons. The lawyer lives on the engineer's quarrels and on the relations which, by his ingenuity, he has set up between others. The teacher helps to prepare the embryo engineer for his admission into a cold-blooded world and promptly forgets him in the further pursuit of embryology.

It is the engineer who harnesses the Niagaras of the world to transform the night of our cities into noonday, and to turn the wheels of commerce. It is the engineer who develops the mining and furnishes the metal with which he builds machines that by their ingenuity compel us to stand in awe and admiration. It is the engineer who produces the steel to form a network of highways over our continents and that makes possible the myriads of floating palaces on our oceans. It is the engineer who has abolished famine and pestilence. It is the engineer who has annihilated distance with his telegraph and his telephone. It is the engineer who has made possible the conquest of the air. It is the engineer who places in the hand of the president of a nation the power whereby he is able with a touch to remove from a point thousands of miles away a barrier of nature separating two oceans. It is the engineer who furnishes the worker in the golden west with the machines whereby millions of bushels of wheat are each year made ready to enter the hopper that the engineer has constructed. It is the engineer who has made Canada of to-day what she is.

So much for generalities. They are all accomplished by the summation of the efforts of individuals. Each of you remaining in engineering must do his part. In conclusion, permit me to impress upon you the necessity of upholding the high ideals of the engineering profession, the high ideals of this University and President Falconer, the high ideals of this faculty and Dean Galbraith.

J. W. Ferguson, '10, who has been with the Toronto Structural Steel Co., is now with Messrs. McGregor & McIntyre, structural and iron workers, on the erection of their new plant on Shaw street, Toronto.

A. Sedgewick, '09, is in the highway branch of the Department of Interior of Ontario at the Parliament Buildings, Toronto.

J. N. Wilson is assistant engineer for the Hydro-Electric Power Commision of Ontario at Toronto.

G. M. Mickler, B. A. Sc., '13, is sales engineer in Ontario for the Hydro-Electric Power Commission.

E. R. Gray, B. A. Sc., '13, is district engineer east of Yonge street for the Sewers Department, Toronto, Ont.

BRIDGES AND SUB-MARINE TUNNELS

By Henry Grattan Tyrrell, C.E.
Consulting Engineer, Chicago.

Bridges and Tunnels Compared

Bridges have always been a more favored means of communication than tunnels. Both are very ancient, for adjoining the bridge over the Euphrates river at Babylon in Assyria, was a tunnel under the river, 12 feet wide and 15 feet high, lined with brick. It is said to have formed a passage way between two palaces on the opposite banks, and there is little doubt but that careful records were kept to ascertain the comparative cost of bridge and tunnel. Tunnels were used also during the early days of Egypt and India, and also by the Romans, for an old Roman tunnel 6 by 10 feet, and 3½ miles long, drained Lake Fucino, while another one 3,000 feet long connected Naples with Pozzuoli. The latter was 22 feet high at the centre, with a normal width of 25 feet which tapered out to 75 feet at the ends. Tunnels were occasionally used through the succeeding generations, but the greatest impitus developed in the beginning of the nineteenth century, and particularly after the advent of railroads about 1830.

A submerged floating tube with its centre part deep enough below the water to allow ships to pass over it, was invented and patented by J. J. Alexander M'Carthy in 1812, and following out the tube idea, De la Haye of England, proposed in 1845, building tunnels by sinking wrought iron tubes, and the method was revived in 1869 by Martin and le Gay of France, for a proposed one under the English Channel, and again in the following year, for the same place by J. S. Story. These early efforts were plainly the basis of the later constructions at Detroit, and LaSalle St., Chicago. Until recent years, however, tunnels were considered suitable only for locations where bridges were impracticable or impossible.

Their chief advantage is the formation of a communication across the water that is free from interruption and open at all times for travel, thus saving much time. At Detroit, the saving of time by the use of the tunnel is 15 to 20 minutes for passenger trains and three to four hours for freight trains. As compared with high level bridges, tunnels require much less land area for their approaches, and the cost of real estate is proportionately less.

The objections to tunnels are many, some of them being as follows:

(1) Approaches must either be long or have a steep grade.

(2) Unless elevators are used, the entrance to the tunnel must be a long way back from the water, which is avoided by an opening span.

(3) For rivers of ordinary width, vehicles would travel a mile or more, and pedestrians at least half as far, in order to traverse a water width of only a few hundred feet.

(4) The time consumed in passing through a tunnel is greater than crossing on the level, in proportion as the tunnel is longer than a moving bridge.

(5) They are usually insufficiently supplied with air and light.

(6) They have no advantage over a bridge in winter seasons, during the period when shipping is discontinued, and bridge openings unnecessary.

(7) Tunnels are disliked by the public, and are tolerated only from necessity.

(8) Their first cost is frequently ten to fifteen times that of a bridge with an opening span.

(9) They need ventilating, pumping and lighting, and have a high maintenance cost if end lifts are used.

(10) An enormous amount of energy is wasted by people and animals in climbing up the long approach grades.

(11) If it becomes necessary to deepen the channel, the whole tunnel may have to be rebuilt, and during the rebuilding, all traffic is stopped.

(12) Tunnels can rarely have more than two tracks while bridges can have many.

Hydraulic lifts or elevators may be used at the ends instead of graded approaches, as on the Mersey river tunnel at Liverpool, and the tunnel at Glasgow, thus saving a long travel at each end. Some of the objections to graded approaches may be avoided by placing endless cables at each wall, 3 to 4 feet above the floor, so that vehicles or loads which need assistance can make connection to the moving cables.

The time required for building tunnels is much greater than for bridges of the same capacity. One under the Mersey river, a mile in length, was building for four years (1882–1886).

The first tunnel under the Thames, at London, was begun in 1804, but it was soon abandoned. A small drift 923 feet long was made to within 150 feet of the other shore, the vertical shaft being only 8 feet in diameter. It was intended to form two adjoining passages 13 feet 9 inches wide, and 16 feet 4 inches high at the centre, with a total length of 1135 feet. Work was again commenced in 1825 between Rotherhithe and Wapping, under the direction of Isambard Brunel, and it was completed in 1841, after a period of seventeen years, though for seven years construction was stopped. It was first intended to sink spiral shafts 200 feet in diameter at the ends, for a 40-foot roadway, but as completed in 1841, these diameters were reduced to 50 feet, for pedestrian travel only, the bottom of the shaft and tunnel being 65 feet below the street. During the seventeen years, more than $2,500,000 was spent on its construction. It was driven through liquid mud and cost $2,170 per lineal foot. It is now used by the East London Railway. The second tunnel under the Thames at London was completed in 1869 under the direction of Peter Barlow, shields being used both by Barlow and Brunel.

The Severn river tunnel, four miles in length, started in 1873, was completed after thirteen years. It accommodates a double line of railway, and the lowest part is 60 feet below low water, or 100 feet below high water. Material was removed through four vertical shafts.

It was proposed in 1883 by Maynard and Cooke, to place another tunnel under the Thames, with a 38-foot road and two 8-foot walks. The tube was to consist of wrought iron plates and arch ribs lined with a brick and concrete casing 3½ to 8 feet thick. Sections 60 feet long with closed ends were to be built on shore and then floated out into position and sunk, the method being similar in some respects to that proposed in 1845, and revived in 1869-70 for a proposed tunnel under the English channel. A later adaptation of the method was used for a recent tunnel in Chicago.

The great progress made in tunnel construction during the last twenty years due to the use of improved shields and other modern appliances, has made it possible for tunnels to compete with bridges, for crossing water courses, where piers cannot be used, such as those at Sarnia, East Boston and New York.

A tunnel under the Detroit river with double bores of 18½ feet was proposed in 1855, and work was commenced in 1870. As bed rock is 85 to 90 feet below water, the tunnel was placed 80 feet down, leaving 20 feet of soil above it. After 1600 feet of the approach had been dug, it began to cave in with great loss, and in 1872 the work was abandoned. It was commenced again in 1880 and finished after four years. Twin steel tubes of 3-8 inch metal, in lengths of 260 feet, were built on shore with sealed ends, floated out over their final position and sunk in trenches previously dredged in the river bottom. The tubes are each 16 feet wide and 16½ feet high. The closed portion between portals is 8310 feet long, and the open cuts at the ends with grades of 1½ and 2 per cent., add 4480 feet more. Its total cost was $4,775,000, equivalent to $241 per lineal foot of bore for the approaches, and $332 per lineal foot of bore for the sub-aqueous part, or a total average of $273 for that part of the work between portals. Benefiting by past experience, the work could probably be duplicated now, for an average cost of $225 to $250 per lineal foot of bore. Steel in the tubes cost $112 per ton delivered at the site, and $145 per ton in place. Bids on the trench method as built were $2,000,000 less than by the use of shields.

The St. Clair river tunnel between Port Huron and Sarnia, completed in 1890, has a total length of 6,000 feet, the part under the river being 2310 feet long. The inside diameter is 19 feet, 10 inches, and it was driven through clay at the rate of 230 feet per month. It cost $333 per lineal foot of bore between portals, but with present (1912) prices, this would be increased to $350 or $375 per foot.

Several tunnels under the rivers at New York have all been made with the use of compressed air and shields. The two Pennsylvania railroad tunnels under the Hudson, with 23-foot external diameter, were lined with cast iron and concrete. They cost $256 per lineal foot of bore, or $1.04 per cubic foot inside, not including experiments. Both of these tunnels and the next one described, were driven with compressed air and shields, and their tops are 40 feet below water.

The Hudson and Manhattan Tunnel under the Hudson at New York, was driven through silt, and cost $1.65 per inside cubic foot including approaches, part of which under the city was very expensive. The portion under the river cost only 79 cents per inside cubic foot, or $144 per lineal foot of bore.

Passenger subways in connection with moving spans have frequently been considered as in the bridge proposed in 1884 by Kinipple for the Thames at London, and some designs for a recent bridge at Vernon Avenue, New York. In the latter case, two separate tubes were proposed, approached at the ends by stairs with intermediate landings.

Cost of Tunnels

The cost of tunnels is usually much greater than moving spans, those through hard rock generally being the cheapest and easiest to build.

Twenty years ago, the cost of one under the channel at Duluth was estimated by two different tunnel companies at $500,000 and $796,000 respectively.

A tunnel 14 feet high and 32 feet wide, proposed for Vernon Avenue, New York, with end grades of 7 to 10 per cent., and steel frames and concrete arch 2½ feet thick for the main portion, had an estimated cost of $450,000. At each entrance were two sets of stairs. The level part of the tunnel was 125 feet long, the top being 7 feet below the channel bottom which was 18 feet deep.

Estimates have been made for a tunnel under the Chicago river at Rush Street, based on a width of 100 feet and 4600 feet long, the cost being roughly reported at $6,000,000 to $10,000,000, while a highly ornamental bascule bridge of the same width, with features somewhat similar to those on the Alexander III. bridge at Paris, would not cost more than $1,000,000, including $200,000 for the purely decorative features.

A tunnel under the Thames at Blackwall (1894), 22 feet wide, and 6160 feet long, one half of which was under ground, was estimated at $4,500,000 without land. Mr. Copperthwaite estimated the cost of a Thames tunnel 21 feet 3 inches inside diameter, at $175 per lineal foot, with an additional cost of $60 per lineal foot for the lining, or a total of $235 per foot.

The cost of tunnels depends greatly upon the depth below the water, and the resulting length. While the greatest ships afloat, such as the Mauretania, have a maximum draft of only 33 feet, modern sub-aqueous tunnels are being placed low enough to provide a deeper water way, those at New York and Liverpool being 40 feet below water, while that at Detroit is 41 feet 9 inches. The Panama Locks are being built to accommodate ships of 45-foot draft.

Heber Coyne, '08, is at present in Europe on work in connection with the development of the Knight gasoline engine abroad.

W. H. MacTavish, B.A., Sc., '11, is assistant surveyor on the survey of the International Alaskan boundary.

T. V. McCarthy, B.A., Sc., '13, is with the roadway department of the City of Toronto.

A REALLY GREATER NEW YORK

As Proposed by T. Kennard Thomson, D.Sc.

This is the day of engineering feats, and we are continually confronted by new schemes to further increase the value of the natural resources of the communities. A new proposal has been made by one of the most eminent men of the profession, T. Kennard Thomson, D.Sc., consulting engineer, of New York, which, if put into operation, will surpass both in magnitude and significance any other engineering work yet attempted. His scheme to remodel New York would reclaim 50 square miles of land and add 100 miles of water front to that city's dock space, thus giving an added taxable value of over $2,000,000,000.

The dock problem in New York has been becoming more and more serious every year, and many requests for dock privileges have been and are daily refused for want of space. This handicap is very detrimental to the commercial growth of the city, and some two years ago Mr. Thomson published a part of his proposed solution, which was in short, as follows:

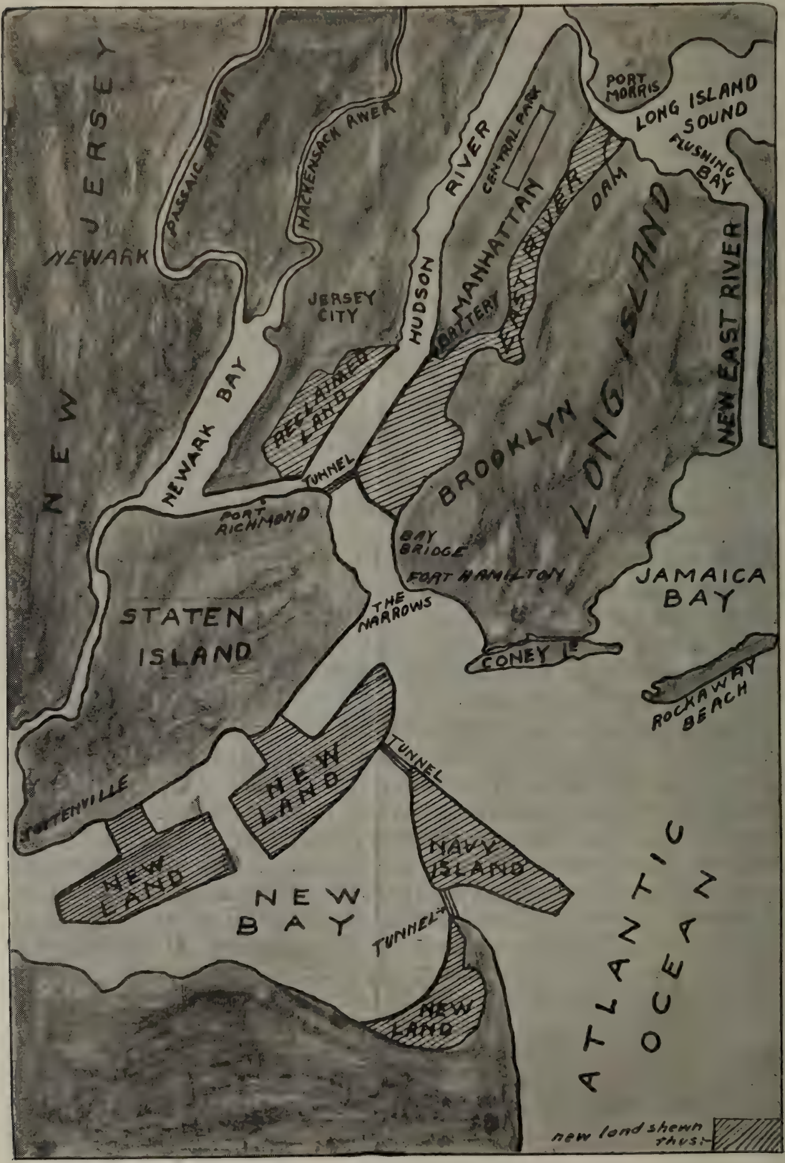
1. To build sea walls from the Battery, half a mile apart and about 4 miles long, thus forming a new neck of land of 2¼ square miles area, leaving a channel of about 1¼ miles between the new Battery and Staten Island.
2. To tunnel to Staten Island and South Brooklyn.

This plan would add 8 miles of new docks, of 1,000 feet or more in length, and equipped with all modern machinery. But even this scheme, vast as it seems would be inadequate owing to the poor wharfage facilities of New York and the fact that over 20 requests for docks have to be refused daily. As soon as the new land and docks would be made available, they would be so enormously valuable, that they would be immediately snapped up, and the congestion would be just as bad as ever.

As soon as this fact became evident to New York, Mr. Thomson, a short while ago, published the second part of his scheme, which he had been holding back. The second part of his solution provides for the building of a sea wall from the end of the new Battery to South Brooklyn, and also a sea wall across East River at Hell Gate, completely cutting the river off from the Sound. He would then reclaim the bed of East River and all that part of the bay south of the Battery and between the sea wall and Brooklyn, about 10 square miles in all. This would eliminate the necessity of the tunnel connecting the new Battery and South Brooklyn, suggested in the first part of the scheme. For several miles the river bed is of solid rock. Where the rock bed ends a dam would be built and the water of the river between the dam and the sea wall would be pumped out. Instead of filling in this part, building operations might be carried on over it, taking advantage of the rock foundation without excavation. Ready-made, clean-cut subways and tunnels would be there, and the laying out of the new part of the city could be done scientifically.

Mr. Thomson proposes to build a new East River connecting

Flushing Bay and Jamaica Bay. This channel would be approximately 40 feet in depth and 2400 feet wide. At the present time the waterfront along Jamaica Bay is not available on account of the shifting of the sands by the tide. In places where there would be



Mr. Thomson's Proposed Plans

docks the depth of water varies from 20 feet to 90 feet during 24 hours, due to the work of the tide. It is claimed that if the proposed channel were cut through from Long Island Sound, the current through this new East River would carry all that shifting sand away from the docks and there would always be sufficient depth of water. This would enable New York to build docks in Jamaica Bay of sufficient length to accommodate the largest ships which will ever be required. These docks she could not supply at the present time without seriously interfering with navigation on the North River and the East River. This in itself would mean a great deal to New York, for if their docks can not accommodate the requirements of the War Department, the work will go to Boston or Philadelphia.

The solution claims as great a gain for Staten Island. The east coast of that island is destitute of shipping facilities and the sea washes its beaches undisturbed. Mr. Thomson proposes to build an island, designated Navy Island, in the illustration, which would act as a breakwater as soon as the harbour had been made deep enough to accommodate ocean liners, and so form a good harbor. He believes that Staten Island will soon be sought as a landing place for these great ships, and so proposes two great projections to provide ample docks. A large area of land could also be reclaimed by filling in Sandy Hook. Navy Island would be connected with Staten Island and with Sandy Hook by means of tunnels. The project would thus admit of a boulevard from Sandy Hook to Long Island Sound, and also a great system of rapid transit lines, thereby solving the problem of car terminal congestion which is the result of the inadequacy of the bridges now extending across East River. It also admits of the construction of a great trunk sewer from Yonkers and Jersey City, down through Staten Island, past Sandy Hook, and far out into the ocean. This latter would be a welcome improvement, since the sewage now dumped into the Hudson, Harlem and East rivers, instead of passing out to the sea, is carried back by the tides, and emits disagreeable and unhealthful odors, which ere long will prove a serious menace to the residents of Manhattan Island.

The Brooklyn Navy Yard would have to be moved in case the bed of the present East River were reclaimed. The present Navy Yard is too small and additional land is not available in Brooklyn. Mr. Thomson proposes to give to the Government the new land built up at Sandy Hook and also Navy Island, which would total three or four times the area of the present navy yard, and would provide three or four times the waterfront of the present navy yard. The large sugar refineries along East River would be given land along the New East River, and the additional amount of land would more than pay for the cost of removing. The same thing would apply to all other owners of land along East River.

It is estimated by the author of the scheme that it would require about ten years to complete the work, and that the expenditure involved would be about $600,000,000, of which about $30,000,000 would be spent annually for labor, and the same amount annually for material during the time of construction. Great as this cost may seem, it is pointed out that the project would be of such infinite benefit to the city, state, and country in general, that it could be carried on as a public enterprise for the benefit of the people, and in such a way as to wipe out the debt of both the city and state. Mr. Thomson thinks that before the work would be finished the new land would not only pay for the construction, but would also bring in enough money to pay for the original outlay. The reclaimed land would be in the most valuable sections of the Greater City, and at least $2,500,000,000 would be added to the taxable values in New York from this land alone. Staten Island is now assessed at $50,000,000, and as soon as this scheme is carried out, the value would be increased to $500,000,000, representing a net gain of $450,000,000. Transportation lines would be kept busy bringing material from every part of the country, and every industry in New York city would be kept busy housing, feeding, and clothing the laborers. It is thought that one of the greatest booms ever experienced in any country would result from the undertaking of this enormous work.

Mr. Thomson, who is the father of the project, graduated from the School of Science in 1886, and since that time has gained a wide and practical knowledge of engineering. After spending three years on actual construction work with the Canadian Pacific Railway in British Columbia, he became bridge engineer for the Ohio extension of the Norfolk and Western Railway, where he had charge of the design and construction of 129 bridges including the large Ohio River bridge at Kenova, W., Va.

Specializing later on Pneumatic Caisson work, he designed and built the caissons for bridges over the Ohio, Monongahela, Susquehanna, Missouri and Harlem Rivers, and for the famous Hartford Stone bridge across the Connecticut River. He has acted in the capacity of consulting engineer on 21 of the largest "sky scraper" buildings in New York, including the Singer and New Municipality buildings, and is now regarded as the foremost authority on pneumatic caisson work in the world.

Mr. Thomson has always been and is still very interested in the affairs of the Engineering Society of the University of Toronto, and of the Engineering Alumni Association. We are deeply indebted to him for the willing and unselfish way in which he has contributed toward our success, not only by articles prepared for Applied Science and papers read before the Engineering Society, but also by his enthusiastic loyalty to his Alma Mater in even the smallest details. Last June the University of Toronto gave her first official recognition of a man in the engineering profession by conferring upon Mr. Thomson the degree of Doctor of Science.

D. H. Fleming, B.A. Sc., '13, is with the Sewers Department at the City Hall, Toronto.

W. H. McTavish, B. A. Sc., '13, who was engaged on the International Alaskan boundary survey during the summer has returned to Ottawa.

THE CORROSION OF IRON AND STEEL AND ITS PREVENTION

H. C. Quail, B.A.Sc.

The subject of the corrosion and preservation of iron and steel is one of great importance and of no little anxiety to engineers who have been investigating some of the problems connected therewith. It is a matter of considerable complexity, and one to which adequate justice cannot be done in the short space of one limited treatise; and so it must be dealt with in a rather sketchy manner: but I shall endeavor to make this article include some of the main facts which our present knowledge shows to be of importance, especially dealing with a few specific problems met with in structural work.

It is a subject upon which a vast amount of literature exists, and upon which a great deal of work has been done; but it is within the last nine or ten years only that the work done has been based upon scientific and technical knowledge, in conjunction with practical experience; so that a very great deal remains to be done.

The complete failure of many types of protective coatings placed on the market in recent years, has only tended to emphasize the increasing necessity of more definite information as to the exact conditions which create and stimulate corrosion of the iron, and also concerning the functions of protective coatings. Both of these must be fully understood before the corrosive action can be combatted successfully.

The greatest difficulties with which the engineer will have to contend, to-day and in the near future, are those connected with bridges and buildings. The commoner materials used in the construction of these may be readily classified into: timber, clay products, plain concrete, reinforced concrete, and the several forms of iron and steel. The first three are eliminated as a basis, lacking strength in tension, compression and shear; plain concrete does not possess sufficient value in tension and shear: therefore, we are thrown back upon iron and its alloys with carbon and some other elements, which we call steel, and which is the most useful of all metals on account of its great strength and general adaptability for constructional work. But, unfortunately, it is also one of the most perishable of metals under the atmospheric conditions that are normal in this and many other countries, and when in contact with water. It is, moreover, easily attacked by nearly all acids, by alkalies under certain conditions, and by air in the presence of water; and, yet, if it can be kept dry and clean, it will remain unchanged for centuries. This characteristic is a very important one, since it is evident that the life of various structures depends either upon the ability of the metallic parts to resist corrosive action; or upon the application of external coatings to check its rapidity.

Dry air at the ordinary temperature has remarkably little effect upon steel, as the following illustration shows: Zunstein, in August 1820, placed a polished iron cross on the summit of Monte Rosa, and, on visiting the spot twelve years later, he found the iron quite free from rust, and with only a slight bronze-colored tarnish upon the surface. At temperatures much above the normal, oxygen, of course, readily attacks iron; but for rusting to occur at the ordinary temperature, and at temperatures below and not much above the normal, the presence of water is essential.

In damp situations, as is well-known, to the cost of everyone, iron and steel both oxidize rapidly, becoming converted into the familiar red rust. That process is shortened by the presence in the air of carbonic acid, nitric acid, sulphuric and sulphurous acids from the combustion of coal and imperfectly purified coal gas, such as the gas companies are allowed to sell, chlorine and hydrochloric acid from chemical works. These acid gases are not nearly so injurious in the absence of water as in its presence; and, generally it may be stated that the cleaner and drier the air, the longer the iron will last in it. A remarkable instance, however, of the preservation of unprotected iron in an atmosphere by no means dry, is that of the celebrated iron pillar in the Mosque of Kutab, near Delhi, India, built up of iron blooms forged nearly three thousand years ago, yet said to be still so free from rust as to be merely tarnished upon the surface. Some people claim that the iron made in those days was much superior to the present day product: even so, taking that for granted, would it be possible for us to produce sufficient iron to supply our demands, if we were to use the methods employed at that time? The question is answered when we consider that in the year 1900, the United States of America produced 14,000,000 tons of pig iron, and, in 1910, 27,650,000 tons,—doubling the output in ten years. The increase in the annual output of Canada in the same period is even more phenomenal,—from 167,170 to 912,371 tons.

The prevention of corrosion is tantamount to increasing the available supply, not only of ore, but also of the fuel necessary to produce it. The importance of this is evident when we consider that it requires four tons of coal or its equivalent to abstract and prepare one ton of steel from the ore.

A pertinent comment upon modern methods of manufacture in relation to corrosion is found in the following quotation from a paper read by Sang before the Engineering Society of West Pennsylvania:—"Carelessness of manufacture which tends to heterogeneousness is an invitation to corrosion, and in itself goes far to explain why modern steel, which is tortured into shape at such a high speed that the molecules are not permitted to re-adjust themselves, is said to be more corrodible than metals produced generations ago. In those days, iron and steel were produced in small quantities without the addition of other metals, and were rolled slowly and allowed to cool naturally." To that statement, may be added the fact that the tonnage-craze of to-day makes it possible for large quantities of poorly made steel to pass without proper inspection. However, since it is not practicable in present times for us to return to the former laborious processes of manufacture, our problem must be solved by modern economic methods.

The theories brought forward to account for the corrosion of iron may be classified as:—the Simple Oxide Theory, the Acid Theory, the Electrolytic Theory, the Hydrogen Peroxide Theory, and the Biological Theory. Each of these receives a certian amount of support, although the advocates of each theory will not admit the possibility of another being correct, except in so far as the two may overlap, and this they all do to a certain extent.

1. A Simple Oxide Theory. This was the original theory, and the simplest of all those advanced; it merely meant that the process of rusting was regarded as an ideal example of ordinary oxidation, such as obtains when iron is heated to 200 deg. C. and upwards in dry air. It was soon shown to be incomplete by the discovery that the presence of liquid water was essential to corrosion, in addition to air or oxygen gas.

2. The Acid Theory. It was formerly accepted without question among chemists that the rusting of iron commenced with an attack by carbonic acid or some other acid. Water containing carbonic acid in solution first attacks the iron thus:—$Fe + H_2CO_3 + H_2$ forming ferrous carbonate which dissolves in the water, and hydrogen which escapes and becomes oxidized by the oxygen in the water. The ferrous carbonate is immediately oxidized by the oxygen dissolved in the water, with the formation of red ferric hydroxide, and liberation of the carbonic acid which again attacks more iron. $4FeCO_3 + 6H_2O + O_2 = 2\ Fe_2\ (OH)_6 + 4CO_2$
This process continues until the whole of the metal is converted into a mass of red rust. The rust which adheres to the iron forms a porous, hygroscopic mass of oxide, which, by holding the water and carbonic acid in contact with the metal, accelerates the rusting. In this respect, iron differs greatly from other metals such as lead and copper, which, when exposed to the action of air and moisture, become coated with a film of oxide, or insoluble compound, which serves to protect the metal beneath and prolong its life.

In that connection, it may be noted that the rust produced under ordinary atmospheric conditions usually contains some carbonic acid.

There is no doubt that the process described in the Acid Theory takes a very active part in the aerial rusting of iron; but, within the last nine or ten years, other theories have been proposed to account even more fully for that corrosive action.

3. THE ELECTROLYTIC THEORY: About 1903, Whitney, an American investigator, proposed an "electrolytic" theory, denying that the presence of an acid was essential, and maintaining that iron could rust in the presence of oxygen and water alone. Walker, Cushman, Gardner, and others assert that the process is purely electrolytic. Their explanation is as follows: The water condensed on the surface of the iron, or in which the iron is immersed, is supposed to be dissociated to a small extent into free hydrogen and hydroxyl ions carrying opposite electrical charges; a minute quantity of the metal iron is supposed to dissolve in the water, forming free ferrous ions, a proportionate number of hydrogen ions becoming deposited on the surface of the metal, and losing their electric

charges. In the meantime, the ferrous hydroxide, formed by the union of the ferrous ions in the water and the hydroxyl ions, becomes oxidized and separates out of solution as red ferric hydroxide or rust. More metallic iron then goes into solution, and this continues indefinitely. Thus, the action is considered to be wholly electrochemical, the rate being simply a function of the electro-motive force and the resistance of the circuit.

The proof of this Electrolytic Theory would seem to depend on the proof,—first, that chemically pure water is capable of conducting a current; and second, that pure iron can dissolve in chemically pure water. As the difficulties in the preparation of chemically pure water, free from the least trace of carbon dioxide, have hitherto proved insurmountable, the proof of the Electrolytic Theory still remains to be established; and it is vehemently disputed by the supporters of rival theories.

4. THE HYDROGEN PEROXIDE THEORY: A fourth theory was suggested by Dunstan, Jowett, and Goulding a few years ago, which has become known as the "Hydrogen Peroxide Theory." Dunstan, also, believes that iron can rust in the presence of oxygen and water alone, without the assistance of any acid. The results of his experiments would indicate that, when certain substances are dissolved in water, the formation of rust is prevented, and moreover, that either the formation of hydrogen peroxide is prevented or its destruction is assured: the second fact established is that, on the other hand, rusting readily occurs in the presence of other substances which have no effect on hydrogen peroxide. These investigations, therefore, concluded that hydrogen peroxide plays an important part in the rusting of iron, although, up to that time, they had been unable to detect a trace of dissolved iron in the water, containing hydrogen peroxide, in which certain other metals, such as zinc and aluminum, were known to be corroding. However, in a more recent paper, Dunstan and Hill claim to have found traces of hydrogen peroxide present in the water during the oxidation of iron.

This theory does not seem possible, since, in the first place, hydrogen peroxide when chemically pure has no effect on iron; and, in the second place, iron has been shown to rust easily in the presence of potassium iodide and other substances which are similar in so far as they decompose hydrogen peroxide.

(*To be Continued*)

H. A. Whately, B.A.Sc., '13, is inspector for the Provincial Hydro-Electric Commission at Chatham, Ont.

Among those who returned to play in the "Old Boys" rugby game on October 4th were: Hugh Ritchie, '10, of Calgary, and H. G. Kennedy, '08, of Cobalt, Ont. Angus Campbell, '10, also made his annual visit to this event.

A. G. Code, B.A.Sc., '10, is in the test department of the Canadian Westinghouse Co. at Hamilton, Ont.

AN IDEAL INTEREST FOR ENGINEERS

To the Editor of Applied Science:

Sir,—There are somethings which the engineer who would be accorded professional status cannot afford to neglect. Native ability and sound technical training must be supported by character and dignity. The capacity to co-operate harmoniously with others in carrying out large enterprises is indispensable. Nevertheless, the possessor of all these desirable characteristics will fail in the struggle for the larger succes if he lack culture and the ability to participate in those common interests which concern educated men the world over. Familiarity and intelligent sympathy with activities that make a universal appeal to humanity constitute the engineer's best letter of introduction, and if his recognition as a professional man has been slow in coming, it is, in a measure his own fault. Too often, be it reluctantly said, he has lacked the broad interests which alone could place him alongside the leaders of thought and action in his community.

Among those higher activities which form a meeting ground for the outstanding men in every country, none is more worthy of the attention of the engineer than the movement to abolish international warfare, As an intelligent man, he cannot plead lack of interest in this, one of the problems of the ages. The welfare of every human being now living or yet to live, whether civilized or uncivilized, bond or free, is inextricably involved. Surely there is need for earnest thought, and if so-called educated men are without opinion on the great issues of the day, what shall we expect of those to whom the advantages of higher education have been denied?

A rare opportunity for public service in the field of internationalism is afforded the undergraduates, graduates and faculty of the University of Toronto in the recent formation of the International Polity Club. The purpose of this organization is not the violent and indiscriminating advocacy of peace, but the calm, dispassionate study of the means by which the political relations of human groups or nations may be so shaped as to result in the maximum of prosperity and happiness for each. It is believed that investigation will show the economic futility of armed aggression and its utter variance with the best interests of the aggressor himself. The ideal of the Club is not so much the spreading of the peace idea abroad, working as an organization, as the creation in each member, by study and discussion, of firm convictions on this most vital question. The formative influence upon public opinion attending the going out from this University each year of a band of earnest graduates with sound views on international problems can scarcely be over-estimated.

To the undergraduates in Applied Science and to the graduates resident in or near Toronto, the activities of the International Polity Club should appeal strongly. The interest which has already been manifested by the undergraduates is gratifying evidence of an existing desire for fuller understanding of international questions. It is to be hoped that the meetings which will be held monthly throughout the University session, will receive the strong support, not only of the undergraduates, but of those graduates in engineering who may be able to attend.

Yours very truly,
C. R. Young.

Faculty of Applied Science,
October, 1913.

DUNDASS-HUTTON

We extend our congratulations to Mr. Chas. S. Dundass, B.A., Sc., '06, who was married on the evening of October 6th to Miss Hattie H. L. Hutton, only daughter of Mr. and Mrs. Geo. Hutton, Lachine, Que., at the residence of the bride's parents. The ceremony was performed by the Rev. Johnson Seller, assisted by Rev. W. A. Morrison, of Dunvegan, Ont. Mr. and Mrs. Dundass left for a trip to Toronto and other western points before taking up residence at Lachine Locks, P.Q., where Mr. Dundass is on the staff of the Dominion Bridge Co.

The members of class '13 have apparently been a vulnerable target for cupid's darts. Among those to fall victims to cupid's aim since graduation last April are: Messrs. E. R. Gray, B.A.Sc., J. J. Phillips, B.A.Sc., F. R. Sims, B.A.Sc., R. W. Diamond, B.A. Sc. To them we extend our congratulations and best wishes.

We extend to Mr. Edgar Harold Niebel, B.A.Sc., '11, our hearty congratulations on his marriage to Miss Annie C. Scott, A.T.C.M., of Winnipeg, on Wednesday afternoon, September 24th. The ceremony was performed by Archdeacon Fortin in Holy Trinity Church. Mr. and Mrs. Niebel will reside at Linden Court apartments, Winnipeg.

F. R. Sims, B. A. Sc., '13, is appraiser in the Department of Customs at Ottawa, Can.

W. L. McFaul, B.A.Sc., '13, is with the city engineer of Port Arthur supervising the construction of street railway extensions.

H. O. Leach, '14, who was leader of the School orchestra last year, is with the city engineer's office at Port Arthur. Mr. Leach has just recovered from an attack of scarlet fever and hopes to be back at the School next year.

A number of our graduates are with the Canadian Copper Co. at Copper Cliff, Ont. Among them are the following: C. A. Bell, '13, in mines maintenance department; K. L. Newton, '13, assistant chemist; D. G. Sinclair, '13, in the mechanical department; T. R. Buchanan, '13, in the mine surveying department; D. B. Cole, '11, in the smelter maintenance department; Allen Brock, '10, head mine surveyor.

APPLIED SCIENCE

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EDITORIAL

DINNER TO DEAN GALBRAITH, DECEMBER 5th, 1913

The annual "School" dinner has always afforded a welcome opportunity to the graduates to come together, renew old acquaintances and revive interest in "School" affairs in general. This year offers special opportunities to make the dinner the most successful and enthusiastic event in the history of the University. It will mark the celebration of the fiftieth anniversary of the Dean's freshman days at the University, and also the celebration of the thirty-fifth anniversary of his appointment to the staff in engineering. We all know how energetically and faithfully he has given his invaluable services to the founding and upbuilding of the "School" and to furthering the interests of the profession, and of those who were so fortunate as to reap the benefits of his masterly instruction and to feel the encouraging influence of his sympathetic and magnetic personality. We therefore welcome this fitting opportunity to express our appreciation of and loyalty to Dean Galbraith, whose sympathetic interest in us has endeared him to the heart of every "School" man. The graduates of the "School" owe him a debt which they can never repay. The undergraduates, in whose heart the Dean is regarded with the fondest respect, will, upon graduation, realize that they owe to him their truest allegiance throughout their professional life.

This dinner is not being arranged entirely by the Engineering Society. The various branches of the Engineering Alumni Association are also taking an active part in the organization and preparation for this great family reunion. It is expected that there will be several class re-unions during the same week, so that it promises to be a week of genuine re-union and rejoicing. It being felt that the Easter term is overcrowded with University functions, December 5th has been chosen as the most acceptable date for the occasion. In order that memories of the early days of the "School" may be fittingly refreshed in the minds of the early graduates, the large drafting room in the Old Red School has been appropriately accorded the honors of this event.

It is expected that every graduate who possibly can, will share a part in making this the most successful event in the history of the "School." Further notice, embodying the details of the plans and preparations will be forwarded by mail to as many as we can reach in that way.

INDUSTRIAL CHEMICAL CLUB

The Club once more starts an auspicious year, under the following executive, which was elected on the afternoon of Monday, October 6th: Hon. president, Dr. Ellis; hon. vice-president, Prof. J. W. Bain; president, W. E. Phillips, '14; vice-president, W. Uffelmann, '15; secretary-treasurer, C. C. Anderson, '16; curator, J. McLean, '17; 4th year representative, O. G. Lye; 3rd year representative, L. G. Glass.

To date the members have participated in one excursion and one "dinner meeting." On Saturday morning, October 11th, Prof. Ardagh conducted a large party to the new plant of the Consumers' Gas Company, across the Don, where, through the courtesy of the management, a few most profitable hours were spent. The various operations of coal-retorting, gas-purifying and by-products recovery were thoroughly explained and inspected, while an excellent opportunity to examine construction was afforded by the buildings in course of erection.

On Monday, October 13th, the first "dinner meeting" of the session was held in the Tea Pot Inn at 6.30 p.m., and as usual, proved to be both entertaining and beneficial. Papers on the following subjects were presented: A. E. Wigle, '14, The Conservation of

Natural Energy; L. G. Glass, '15, The Utilization of Wood Waste; S. J. Krug, '16, Some Problems in Chemical Manufactures.

On these and several other topics of interest to "Schoolmen" and of particular concern to chemists, chemical engineers and metallurgists, discussions were raised and generally partaken in. As ever, a spirit of informality possessed the gathering, thus fulfilling one of the aims of its existence—the promotion of good fellowship among the members. Everything, indeed, points to a most successful session—an enterprising executive, enthusiastic members, a balance on hand and a library table well stocked with current chemical literature.

OBITUARY

JAMES HARRISON

Mr. James Harrison, of 107 Yarmouth Rd., Toronto, who was a member of class '87, died suddenly on Saturday, October 11th, 1913. Mr. Harrison was engaged as foreman at Woodbridge for the York County Highway Commission. When walking down Main Street just after dinner he was seized with a stroke of paralysis. A doctor was immediately summoned, who ordered that the stricken man should be hurried to a hospital as quickly as possible, in hopes that an operation might save his life. He was rushed to the Western Hospital, Toronto, in an ambulance, but the unfortunate man died about two hours after being admitted.

Mr. Harrison, who was 55 years of age, was favorably and widely known throughout the country. To his wife and family we extend our sympathy in their sad bereavement.

THE SONG OF THE TRANSITMAN

(Apologies to Robert Service)

This is the song of the transitman, as he stood on the track alone
His rodman true and his chainman, too, had jumped the job for home.
With it twenty below and four feet of snow, his feet were frozen to stone.

"I belong to this damn'd profession; I'm a railroad pioneer.
I came with the first,—Oh God, how I've cursed this business, but still I'm here.
I've dragged the chain thro' sleet and snow; I've rodded the bush and bog;
I ran this grade that the dagoes made, and I've lived the life of a dog.

This surveying is worse than slavery; there's never a time to rest,
You're up with the sun and you've never done; it sure beats hell at the best.

With cross-sections, curves and spirals,—oh it's maddening just to think
Of the years and years of toiling and the money spent in drink.

In the early days of the first prelim. of this hanged old C.P.R.
We never dreamt when we built this line that things would turn out as they are;
We've carried our pack and transit, and trailed for months in the woods,
And in spite of this cursed country, we've always produced the goods.

We were just like a great big family and the chief was the best sport there;
We lived a free, hard, healthy life, with nerve to do and dare.
We took sights on Polaris with instruments none too true
And accepted approximations, that Louis B. would not have us do.

Twenty years on location, wandering thro' the land,
Contouring the sides of canyons, with rivers to be spanned,
Mapping the hills and valleys for a company making gold:
Twenty years on location—twenty years, and I'm old.

Old and weak, but no matter; I guess it's time to pay the bill:
I'll get leave from the company to-morrow and go to town for a spill.
These cities are hell, but I'm lonesome,—I'll just lie down on the bed.
To-morrow I'll go . . . . to-morrow
. . . . and I'll see no more of the red.

. . . . say cook, my belly is addled, with that mulligan of sow-belly and joint.
. . . . men, you devils, I'll kill you if you kick that reference point.
. . . . . . how far is the camp, Bill; play up "School" play the game
Oh God, this is awful weather,—always snows the same.

This is the song of the transitman, as he lay in his room alone
In a cheap hotel and drunk as well; as he stiffened out like stone
The only reward of his life long work,—a man without a home.

E. R. Williams, '11, is assistant electro metallurgist with Northern Aluminum Co., at Shawinigan Falls, Que.

Mr. J. P. Watson, B.A.Sc., '04, is on the staff of the St. Lawrence Bridge Co., Limited, Beardmore Building, 59 St. Peter St., Montreal, P.Q.

J. McNiven, B.A.Sc., '10, is employed on the construction of the Dominion Government grain elevator at Moosejaw, Sask.

W. E. Robinson, B.A.Sc., '11, and R. F. Scandrett, B.A.Sc., '11, are on C.P.R. townsite work on the Kerrobert-Lacombe line, Sask.

M—*Continued*

Mace, F. G., '05, is patent examiner in the Department of Agriculture at Ottawa, Ont.

Madden, J. F. S., '02, is on the staff of the erecting engineering department for the Canadian General Electric Co., at Winnipeg, Man.

Madge, N. G., '08, is chief chemist for the Continental Rubber Co., of New York.

Madill, H. H., '11, is a member of the firm of Craig & Madill, architects, Manning Chambers, Toronto. He is also lecturing in architecture in the faculty of applied science.

Main, W. T., '93, is division engineer, C. & N. W. Ry., at Wells St. Depot, Chicago, Ill.

Maisonville, A. W. R., '10, is on the designing staff of the Dominion Bridge Co. at Lachine, Que.

Malcolmson, W. S., '07, his last address with us is Box 820, Haileybury, Ont. We do not know his present occupation.

Malone, J. E., '08, has Brechin, Ont., as his home address.

Manning, N. H., '09, is district manager for the Canadian Inspection & Test Laboratories, Limited, Toronto.

Manson, G. J., '04, is engineer for the Grenville Board Co., at Penetang, Ont.

Manson, A. B., '09, is city engineer for Stratford, Ont.

Marani, C. J., '78, is designing and consulting structural engineer for the Russia Cement Co., Anacortes, Wash.

Marani, V. G., '93, is city building inspector, City Hall Cleveland, Ohio.

Marlatt, K. D., '08, is chemist and tannery superintendent for the Marlatt and Armstrong Co., Ltd.' Oakville, Ont.

Marr, N., '10, is with C. H. & P. H. Mitchell, consulting engineers, at Prince Albert, Sask.

Mariott, F. G., '03, is chemist and superintendent of the asphalt plant of the city testing laboratory, Toronto.

Marrs, C. H., '02, is designing engineer for the Hamilton Bridge Works, Hamilton, Ont.

Marrs, D. W., '06, is designer and estimator for the Riter-Conley Mfg. Co., Pittsburgh, Pa. His address is 732 Summerlea St.

Marshall, R. J., '08, is demonstrator in strength of materials at the University of Toronto.

Marshall, S. A., '07, of 44 11th Ave., Lachine, P.Q., is with the Dominion Bridge Co.

Martin, F., '87, is a practicing physician. We have not his present address.

Martin, J. C., '11, has as his last address on our records, 5021 Sherbrooke St., Westmount, P.Q.

Martin, W. H., '10, is demonstrator in the department of drawing at the University of Toronto in the faculty of applied science.

Martin, T., '96, is assistant divisional engineer for the Western Division of Canadian Pacific Railway at Calgary, Alta.

Martindale, E. S., '09, has a practice as land surveyor at Aylmer, Ont.

Martyn, O. W., '09, is engaged in survey work at Regina, Sask.

Mason, D. H. C., '07, is a member of the firm Akers, Mason & Bonnington, chemical engineers, Toronto.

Matheson, W. C., '01, is with MacKenzie-Mann & Co., at Joliette, Que.

Mathison, P., '01, has 607 Jones Ave., Braddock, Pa., for his address.

Matthews, A. C., '10. His address is 89 St. George St., Toronto.

Maus, C. A., '03, has Paris, Ont., for his last address with us.

Maxwell, W. A., '06, address not known.

Maynard, H. V., '07, is with the Canadian General Electric Co., at Toronto, Ont.

Meader, C. H., '10, is engineer for the colonization roads branch of the Department of Public Works of Ontario.

Meadows, C. A., '11, is taking a post graduate course in engineering at the University of Toronto.

Meadows, W. W.,'95, is with the Department of Public Works at Maple Creek, Sask.

Melson, J. W., '07, is in the roadways department at the City Hall, Toronto, Ont.

Menzies, J. M., '06, is engaged in missionary work at Wei An Hsien, North Honan, China.

Mennie, R. S., '02, is with the Crucible Steel Co. of America, at Pittsburgh, Pa.

Merrill, E. B., '91, has Moose Jaw for his address.

Merriman, H. O., '10, is draftsman

for the Smart-Turner Machine Co. at Hamilton, Ont.

Middleton, H. T., '01, has Palisade, N.J., as his address.

Mickle, G. R., '88, is mine assessor for the province of Ontario. His office is at the Parliament Buildings, Toronto.

Mill, F. X., '89 (deceased).

Miller, D. J., '10, address not known.

Miller, L. Haun, '00, is sales agent for the Bethlehem Steel Co., Cleveland, Ohio. His address is 10218 Hampden Ave., Cleveland.

Miller, L. R., '06, has Orillia for his home address.

Miller, M. L., '06, is in the engineering department of the Winnipeg City Light & Power Co. Address 54 King St. W., Winnipeg.

Milligan, G. L., '08, has Brampton, Ont., for his home address.

Milligan, F. S., '10, is on the city engineering staff at Saskatoon, Sask.

Mills, G. G., '07, and Mills, L. G., '11, of 89 Glen Road, Toronto, are in the contractors' supplies business in Toronto at 809 Lumsden Building.

Mills, P. E., '10, has charge of the drafting department of the Eisman Magneto Co., New York. His address is 320 W. 56th St., New York, N.Y.

Minns, J. B., '07, is with the Canadian General Electric Co., at Winnipeg.

Minty, W., '94, is with Messrs. Yates & Thom Limited, engineers, Blackburn, Eng.

Milne, C. G., '92 (deceased).

Mines, W., '93, is chief engineer for Honer & Mason, Chicago.

Mitchell, P. H., '03, is a member of the firm C. H. & P. H. Mitchell, consulting engineers, Toronto.

Mitchell, L. C., '11, is with the German-American Sugar Co., West Bay City, Mich., U.S.A.

Mitchell, C. H., '92, is a member of the firm C. H. & P. H. Mitchell, consulting engineers, Toronto.

Mitchell, B. F., '06, is in the city engineers' office at Edmonton, Alta.

Mitchell, A. B., '08, is with N. McLeod, contractors, Montreal, P.Q.

Moberly, H. K., '89, has an engineering and surveying practice at Yorkton, Sask.

Moffatt, R. W., '05, is instructor at the University of Manitoba, Winnipeg, Can.

Molesworth, G. N., '07, is a membe, of the firm of Bovell & Molesworthr architects, 2 College St., Toronto.

Molesworth, J. C. P., '08 (deceased).

Monds, W., '99, is a member of the firm Clark & Monds, contractors and engineers, 88 St. David St., Toronto.

Monk, E. D., '08, is assistant engineer with the General Electric Co. at Cincinnati, Ohio.

Moody, F. H., '08, is mechanical editor of the *Canadian Railway and Marine World.*

Montague, F. F., '06, address not known.

Montgomery, R. H., '03, has a practice as engineer and surveyor at Prince Albert, Sask.

Moore, H. H., '02, has a rpactice as land surveyor and engineer at Calgary, Alta.

Moore, E. E., '04, address not known.

Moore, J. H., '88, is town engineer at Smith's Falls, Ont.

Moore, J. E. A., '91, is consulting and contracting engineer. His address is 10074 Kee Mar Court, Cleveland, Ohio.

Moore, F. A., '03. His address is 44 Fawcett St., Winnipeg. He is in the engineering department of the Canadian Northern Railway.

Moore, W. J., '06, is a member of the firm Morris & Moore, land surveyors and architects at Pembroke, Ont.

Moore, J. M., '07, is engineer for the McClary Manufacturing Co., London, Ont. His address is 478 Waterloo St., London.

Moorhouse, W. N., '04, is designer for Sproatt & Rolph, architects, Toronto.

Morden, L. W., '07, address not known.

Morgan, J. P., '10, is cost engineer for the Orpen Construction Co., of Toronto.

Morice, J. H., '08, his address is 24 Swan St., Schenectady, N.Y. He is switchboard proposal engineer for the General Electric Co., at Schenectady, N.Y.

Morley, P. F., '07, is at the Metorological office, Toronto, Ont.

Morley, R. W., '04, is in the topographical surveys branch of the Department of Interior, Ottawa.

Morphy, J. A., '11, his last address with us is Oshawa, Ont.

Morris, J. L., '81, is a member of the firm Moore & Morris, land surveyors, and architects, Pembroke, Ont.

Morris, C. A., '09, is with the Canadian Copper Co., Copper Cliff, Ont.

F. R. Mortimer, '10, is with the hydro-graphic survey branch of the Naval Service Department at Ottawa.

Morton, G., '09, is city salesman for the Canadian Westinghouse Co., at Calgary, Alta.

Mowbray, F. E. H., '08, is with the Canadian Westinghouse Co., at Hamilton, Ont.

Mullins, E. E., '03, is superintendent of motive power for the Northern Railway Co. at Port Limon, Costa Rica, C.A.

Munro, A. H., '10, is engaged in the Trent Canal office at Cambpellford. Ont.

Munro, W. H., '04, is with the engineering department of the Peterboro Radial Ry., Peterboro, Ont.

Munro., G. R., '05, address not known.

Munro, F. V., '09, address not known.

Munson, A. H., is at Walkerville as bridge inspector for the Canadian Pacific Railway.

Murdock, C. R., '06, is resident engineer for Chipman & Power, at High River, Alta.

Murphy, C. J., '06, is chief engineer for the Crow's Nest Pass Coal Co., at Fernie, B.C.

Murphy, M. H., '11, has a general contracting business in Toronto.

Murray, E. W., '07, is on the engineering staff of the Department of Public Works at Regina, Sask.

Murray, J. D., 07, address not known.

Murray, W. P., '08, address not known.

Murton, J. C., '11, has for his address 681 Moose Jaw, Sask.

N

Nash, J. C., '01, is draftsman with the Canadian Westinghouse Co., at Hamilton, Ont.

Nash, T. S., '02, is with the topographical surveys branch of the Department of Interior, Ottawa,

Nasmith, M. E., '08, is chemist for the Commercial Engineering Co. at Turtle Creek, N.B.

Near, W. P., is city engineer for St. Catharines.

Neelands, E. V., '00, is superintendent of the Drummond & Hargrave Mines at Cobalt, Ont.

Neelands, E. W., '07, is a member of the firm Sutcliffe & Neelands, consulting engineers, New Liskeard, Ont.

Neelands, R. E. K., '07, address not known.

Neelands, R., '06, is on the engineering staff of the bridge department at the City Hall, Toronto.

Neilly, B., '07, is manager of the Penn.-Canadian Mines, Limited, Cobalt, Ont.

Neville, E. A., '09, is a member of the firm Neville & Stewart, civil engineers, Vancouver, B.C.

Nevitt, I. H., '03, is assistant engineer for the sewage disposal plant with the main drainage department of public works, City Hall, Toronto.

Newhall, V. A., '10, is with the department of Interior at Calgary, Alta. His address is 827 3rd Ave. W., Calgary.

Newman, W., '91, has a practice as consulting engineer at Windsor, Ont.

Newton, J., '09, is in the city engineers' department, Toronto.

Newton, W. E., '10, is with the Van Roi Mines, Silverton, B.C.

Nichol, F. T., '10. His address is 261 Stanley St., Winnipeg.

Nicholson, C. J., '94, is assistant engineer for the Hamilton, Guelph & Waterloo Railway, at Hamilton, Ont.

Nicklin, W. G., '05, is assistant superintendent of the Dalm & Kiefer Tanning Co., Grand Rapids, Mich.

Nickel, E. H., '11, is in the office of the Northern Electric & Manufacturing Co. at Winnipeg. His address is 663 William Ave., Winnipeg.

Nixon, C. K., '11. His address is 18 Washington Ave., Detroit, Mich.

Noble, E. S., '11, is with the Canadian General Electric Co., at Peterboro, Ont. His address is 300 Wolfe St., Peterboro.

Northey, R. H., '11. His home address is 42 Forest Hill Rd., Toronto.

Nourse, A. E., '07, is with Clarence W. Noble, engineer, 116 St. Nicholas Bldg., Montreal.

O

O'Brien, E. D., '05. Address not known.

Odell, L. S., '09, is engaged in contracting at Morden, Manitoba.

O'Donnell, V. J., '09, is with the Canadian Westinghouse, Hamilton, Ont.

O'Flynn, W. A., '11, is with the Copper Queen Smelter, at Douglas, Arizona.

O'Grady, W. deC., '08, is engineer

for the Gas Traction Co., Limited, Winnipeg, Man.

O'Hearn, J. J., '09, is manager of the supply department for the Canadian General Electric Co., Toronto, Ont.

Oke, W. V., '11, is sales engineer for the Central Steel & Wire Co., 220 King St. W., Toronto, Ont.

Oliver, E. W., '03, is assistant to the chief engineer of the Canadian Northern Ry. system, Toronto, Ont.

Oliver, J. P., '03, is superintendent of construction for the American Sugar Refining Co., Arabia, La.

O'Neil, C. M., '10, has as his home address Erindale-on-Credit, Ont.

Orr, J. A., '11. His home address is Clarkson's, Ont.

O'Sullivan, J. J., '07, is superintendent and auditor for the Canada Railway News Co.

P

Pace, J. D., '03, is engineer for the Calgary Power Co., at Kananaskis, Alta.

Pace, G., '04, is general superintendent and engineer for the Simcoe Ry. & Power Co., Midland, Ont.

Pae, A. W., '09, address not known.

Palmer, C. E., '10, is exchange manager for the Bell Telephone Co. at Toronto.

Pardoe, W. S., '04, is assistant professor in the department of civil engineering at the University of Pennsylvania, Philadelphia, Pa.

Paris, J., '04, his address is Prince William, York Co., N.B.

Park, D. G., '06, his address is 3031 National Ave., West Allis, Wis., U.S.A.

Parke, J., '04, address not known.

Parker, G. C., '10, is associate editor of the *Motor Magazine*, Toronto. His address is 29 Dorval Rd.

Parker, J. S., '11. His address is Burks' Falls, Ont.

Parkin, J. H., '11, is demonstrator in mechanical engineering at University of Toronto.

Parsons, J. L. R., '01, has a practice as engineer and surveyor at Regina, Sask.

Paterson, G. W., '06, address not known.

Paton, T. K., '07, address not known.

Patten, B. B., '03 and '05, is a member of the firm Rutherford & Patten, engineers and surveyors, St. Catharines, Ont.

Patton, J. McD., '11. His address is 2025 Smith St., Regina, Sask.

Patterson, J., '99, is physicist at the Dominion Observatory, Toronto, Ont.

Paulin, F. W., '07, address not known.

Peaker, W. J., '04, is with the topographical surveys branch of the Department of the Interior, Ottawa, Ont. His address is 545 MacLeod St., Ottawa.

Pearce, K. K., '10, address not known.

Pearson, C. L., '11, has Weston as his address.

Peckover, H. J., '08, is on the designing staff at the City Hall, Toronto, Ont. His address is 205 Dunn Ave.

Pedder, J. R., '90 (deceased).

Pepler, S. J., '11, address not known.

Pequenat, M., '08, is assistant city engineer at Berlin, Ont.

Perrin, W. J., '11, is with the Canadian General Electric Co., at Peterboro, Ont.

Petry, A. M., '09, is assistant manager for Chas. Potter Optical Company, 85 Yonge St., Toronto.

Pettingill, R. E., '06, is chemist in charge of plant number 8 of the Canada Cement Co., Limited, at Port Colborne, Ont.

Philp, D. H., '03, is engaged on the Georgian Bay Canal survey work at Ottawa.

Phillips, E. H., '00, is a member of the firm of Phillips, Stewart & Lee, surveyors and consulting engineers, Saskatoon, Sask.

Phillips, H. G., '08, is associated with the firm Phillips, Stewart & Lee, surveyors and consulting engineers, Saskatoon, Sask.

Phillips, C. A., '10, has 85 Manchester Place, Buffalo, as his address.

Phillips, E. P. A., '05, is assistant to the city engineer at Port Arthur, Ont.

Pick, B. W., '11, is with Smith & Phillips, engineers, at Regina.

Pickering, A. E., '04, is manager of the Tagona Light & Power Co., Sault Ste. Marie, Ont.

Pigott, R. B., '09, has as his address 157 Wentworth St. S., Hamilton, Ont.

Pinhey, C. H., '87, has a land surveying practice at Ottawa, Ont.

Applied Science

TRANSACTIONS OF [illegible] UNIVERSITY OF TORONTO
ENGINEERING [illegible]

[illegible]

RAILWAY ACROSS [illegible]

[illegible]

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